9 5 cont.

21. The method of Claim 12 in which the laser produces a threshold excitation pulse-energy of less than about 1 microjoule with a line excitation of about $5mm^2$ area.

22. The method of Claim 12 which uses β-barium borate (BBO) as a nonlinear optical crystal to increase the frequency of output of the laser.

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REMARKS

A new FIG. 1 has been submitted which labels the boxes. It should be pointed out that these boxes are identified on page 9, line 7-8. The Examiner has also objected to the drawings in not showing the laser component. It is believed that the labeled boxes of FIG. 1 along with the description on page 11, lines 4-8 adequately describe the laser. This laser is a very simple device in that it has no mirrors. Consequently, it is believed that no more detail need to be shown as to the laser, as these simple lasers are well known in the art. A new FIG. 11 has been submitted to correct the molecular structure for DAST and DEST by changing $SO_4^-$ to $SO_3^-$. Identical corrections were made on page 7 of the Specification. A new FIG. 13 has been submitted to correct the absence of any header for the fourth column and to correct the reference numbers as most of the references at the end of this application have been deleted by this amendment. A new page 22 of the Specification is submitted to include the references that are referred to in FIG. 13. A new FIG. 12 has been substituted as the original FIG. 12 was erroneously a duplicate of FIG. 13. There is basis in the Specification for the FIG. 12 in the Examples.

The Summary of the Invention on pages 6-8 has been amended to summarize the invention rather than using language that is like what is contained in claims. Claims 2-11 have

been added based upon the disclosure in the Summary on pages 6-8 as originally filed. Claims 12-22 have been added as a method is disclosed in the application. It is believed that the Applicant is entitled to method claims. A PTO Form-1449 is being prepared and will be filed shortly. Consequently, pages 22-24 have been deleted from the application, except for the references listed on new page 22.

Claim 1 has been rejected under 35 U.S.C. §102(b) on the basis of Forrest et al. Forrest et al. basically discloses a method for making optically nonlinear thin films of organic salts using an organic vapor phase deposition. Forrest et al. discloses some of the compounds claimed in the instant application. In particular, Forrest et al. does not disclose using the compound that they prepared by vapor phase deposition for the emission of light. In order for these compounds to be used for the emission of light it is necessary that they be in solution or polymeric matrices. *See Specification, page 4, line 21 through page 5, page 6, line 2, and page 8, line 20.*

It is well established in patent law that an inventor who discovers a new use for a compound is entitled to a patent which may be in the form of a method claim or the use of the compound in an apparatus. The application now contains both types of claims.

The Examiner has cited Column 6, lines 2-10 which superficially appear to be laser material. However, it is clear that Forrest et al. was not showing the use of these compounds in solution or polymeric matrix for emitting a laser-like emission. This statement by Forrest et al. is basically measuring the second harmonic generation efficiency of the film that they produced. The second harmonic generation implies reducing the wavelength of the external laser into half of the original wavelength. In Forrest et al. the original wavelength was 1.9 microns, but was reduced to 0.95 micron. This was accomplished using a nonlinear optical (second order process). The Forrest

patent does not disclose or suggest the use of the compound made by their process to emit a laser-like emission. Their light emission was from a laser itself. As pointed out above, the compounds that are used with the laser in this invention are either in solution or amorphous state in the polymer matrix. The thin films produced by Forrest et al. are used on a substrate material, such as semi-conductor wafers, glass and polymer sheets (Col. 9, lines 53-57). They are not used in solution or amorphous state as Applicant has developed for producing laser-like emissions.

## CONCLUSION

For the above reasons, it is believed that all of the claims presently in the application, namely Claims 1-22, are allowable. It is respectfully requested that the corrected drawings be accepted. A copy of the corrected drawings is enclosed and they have also been submitted to the Official Draftsperson.

It is realized by the undersigned that the original application was not submitted in proper format. A conscientious effort was made to put the application in better form. If the Examiner has any questions or suggestions, she is invited to telephone the undersigned. An early and favorable respond is respectfully requested.

Respectfully submitted,

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## Deposit Account Authorization

It is not believed that extensions of time are required, beyond those which may otherwise be provided for in documents accompanying this paper. However, in the event that additional extensions of time are necessary to allow consideration of this paper, such extensions are hereby petitioned under 37 C.F.R. §1.136(a), and any fees required therefor are hereby authorized to be charged to our Deposit Account No. 20-0778.

**CERTIFIED MAILING**

I hereby certify that this correspondence is being deposited with the United States Postal Service as **"First Class Mail,"** in an envelope addressed to: Box Amendment, Commissioner of Patents, Washington, D.C. 20231 on January 14, 2003.

Signature: Belinda K. Weiss

## Annotated Version of Changes

Mirrorless solid-state lasing devices are also disclosed which are constructed using the dipolar organic salts doped into solid matrices of poly(methyl methacrylate) (PMMA). Spectrally narrowed directional emission with typical bandwidth of ~10 nm is achieved.

The present invention has the following characteristics:

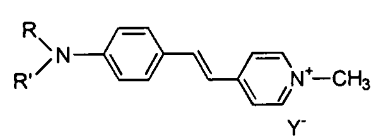
1. A dipolar organic material producing highly efficient laser-like emission at low thresholds without external mirrors.

2. A highly efficient and low-threshold mirrorless lasers (producing laser-like emission without mirrors) comprising:
   (a) organic materials producing highly efficient laser-like emission at low thresholds without external mirrors in solution as active media; and
   (b) a pump laser projecting the excitation beam into the active media.

3. [A mirrorless laser of claim 2, comprising] These organic molecules [having] have large dipole moments as active media.

4. [A mirrorless laser of claim 2, comprising] These dipolar organic molecules are dyes [having] which have large photoluminescence efficiencies as the active media.

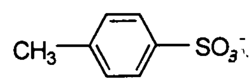
5. [A mirrorless laser of claim 3, comprising] These strongly dipolar organic molecular salts [having] have the following chemical formula as the active media:



where $R$ and $R'$ are the same or different, and comprise a moiety selected from the group consisting of alkyl, substituted alkyl, benzyl, and substituted benzyl, and $Y^-$ is an anion.

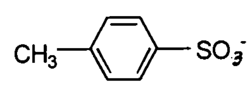
6. [A mirrorless laser of claim 5, wherein] One of the preferred salts is where both $R$ and $R'$ are $-CH_3$, and $Y^-$ is $CH_3OSO_3^-$.

7. [A mirrorless laser of claim 5, wherein] another of the preferred salts is where both $R$ and $R'$ are $-CH_3$, and $Y^-$ has the following formula:



8. [A mirrorless laser of claim 5, wherein] another of the preferred salts is where both $R$ and $R'$ are $-CH_3$, and $Y^-$ is $I^-$.

9. [The mirrorless laser of Claim 5 wherein] a further preferred salt is where both $R$ and $R'$ are $-CH_2CH_3$, and $Y^-$ has the following formula:



10. [A mirrorless laser of claim 2 comprising dipolar] Dipolar organic dyes, such as rhodamine 6G (R6G) and DCM, [having] have large photoluminescence efficiencies as the active media.

11. [A mirrorless laser of claim 2 comprising a] A pump laser is used at a wavelength where the active material has strong absorption.

12. [A mirrorless laser of claim 2 comprising a] A pump laser emitting optical pulses having pulse width shorter than the duration (about <100 picoseconds) of the excitation pulses is preferred.

13. [A mirrorless laser of claim 2 comprising a] <u>A</u> pump source producing 1-100 picosecond pulses frequency-doubled by a nonlinear optical crystal such as potassium dihydrogen phosphate (KDP) <u>is preferred</u>.

14. [A] <u>The</u> mirrorless laser [of claims 6-9 having] <u>preferably has</u> threshold excitation pulse-energy less than about 1 microjoule with a line excitation of about 5 $mm^2$ area.

15. [A] <u>The</u> mirrorless laser [of claim 2 yielding] <u>preferably yields</u> energy conversion efficiencies of more than about 15%.

16. [A] <u>The</u> mirrorless laser [of claim 2 yielding] <u>may yield</u> energy conversion efficiencies of up to about 40%.

17. [A] <u>The</u> mirrorless ultraviolet short-pulse emitting laser <u>of this invention is preferably</u> constructed by frequency-doubling the output of the laser [of claim 2] using a nonlinear optical crystal such as $\beta$-barium borate (BBO).

18. A mirrorless laser emitting picosecond pulses at 300-310 nm <u>may be</u> constructed by frequency-doubling the output of the lasers [of claims 6-9].

19. The mirrorless lasers [claimed above] <u>of this invention</u> are stable under continuous operation for at least about 5 million shots.

20. [A] <u>The</u> mirrorless solid-state laser <u>may be</u> constructed using strongly dipolar organic molecules doped into solid polymeric matrices.

21. [A] <u>The</u> mirrorless solid-state laser [of claim 15] <u>may be</u> constructed using the [active materials of claims 4-7] <u>dipolar organic molecules</u> doped into solid matrices of poly(methyl methacrylate) (PMMA).

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3. D. Moses, Appl. Phys. Lett. **60**, 3215 (1992).